ACTIVITY 4

ACTION = SAVINGS IN CO_2 + $

This activity uses a take-home survey to inventory current use and calculate the savings a household could achieve in dollars and carbon dioxide (CO_2) emissions by undertaking certain conservation measures. It is related to the "Seeing the Big Picture" warm-up and the "How Green Are We?," "The Greenhouse Effect," and "Climate and the Greenhouse Effect" activities.

CRITICAL OBJECTIVES

- Identify sources of CO_2 emissions
- Measure savings in CO_2 emissions resulting from undertaking energy conservation measures
- Recognize additional dollar savings resulting from lower energy consumption

SKILLS

- Collecting data
- Organizing data
- Analyzing and interpreting data
- Computing

GUEST PRESENTERS

Guest presenters could include EPA environmental protection specialists or economists.

BACKGROUND

This exercise requires an understanding and appreciation of the carbon cycle and the importance of maintaining global equilibrium between oxygen and carbon dioxide. Carbon dioxide (CO_2) is a by-product of most living things and many commercial processes. Organisms "burn" food (fuel) to release the energy required for life activities. Humans also burn fossil fuels such as coal and oil for energy. CO_2 is a waste product of these processes. Plants use carbon dioxide for photosynthesis, but concern is growing that the amount of CO_2 is accumulating in the atmosphere because fossil fuel consumption worldwide is outpacing plants' ability to use it.

Carbon dioxide in the atmosphere absorbs and traps heat emitted by the Earth, much as heat is trapped in a greenhouse. The concern of scientists is that if the amount of CO_2 and similar gases in the atmosphere continues to rise, the average temperature of the Earth could

RELATED WARM-UP
C

REFER TO READING MATERIALS
"The Greenhouse Effect"
"Air Pollution"
"Smog"
"Automobiles and Air Pollution"

TARGET GRADE LEVEL
8th-12th

DURATION
40 minutes in first class, plus take-home survey; 40 minutes in second class

VOCABULARY
Carbon cycle
Carbon dioxide
Emissions
Fossil fuel
Greenhouse effect
Photosynthesis

MATERIALS
Chalk
Chalkboard

WORKSHEETS INCLUDED
2

rise 8 to 10°F (4 to 6°C). This is called the "greenhouse effect." While such an increase may sound small, climatologists foresee dramatic impacts on future climates. For example, it could cause polar ice cap melting and a subsequent rise in sea levels, possibly inundating coastal cities and populations. In addition, it could cause species that cannot adapt to these relatively sudden climate changes to die out. (See reading materials on "The Greenhouse Effect," "Air Pollution," "Smog," and "Automobiles and Air Pollution.")

There are many simple energy conservation steps an individual can take to help reduce fossil fuel consumption and cut CO_2 emissions. In addition to the benefits conservation provides for the environment, conservation is a money-saver as well and can provide dollar savings through lower fuel bills. This activity stresses the both of these types of benefits of energy conservation.

WHAT TO DO

First class

1. Review with the students the greenhouse effect concept, including the process by which global CO_2 levels rise and the ramifications for the global climate.

2. Distribute both student worksheets. Explain that the worksheet called "Inventory of Current Use" will help them collect information about the way they and their families use the family car, lighting, and home heating and cooling systems, and their recycling practices. This, in turn, will let them calculate how much CO_2 they may be releasing to the atmosphere. The worksheet called "CO_2 and $ Savings" will let them calculate the CO_2 their families could save by taking some simple conservation steps. In addition, the worksheet can be used to calculate how much money the family can save by conserving.

3. Instruct the students to take the worksheets home and fill them out with their parents. Set a date for them to bring the completed worksheets back, so the class can discuss the results. (If you want to calculate the class-wide CO_2 use and savings potential prior to the class discussion, have students turn in the completed worksheets several days in advance of the discussion.)

Second class

1. Put the potential conservation measures from the "CO_2 and $ Savings" worksheet on the chalkboard. Beside the list draw two columns. Label one

"Current" and the other "Future." With a show of hands, count the number of students whose families currently conserve in each of the ways listed and record it on the chalkboard beside each item. Encourage students to share the reasons for taking (or not taking) specific conservation actions.

2. With a show of hands, count the number of students whose families are willing to conserve in the future in each of the ways listed and record it on the chalkboard in the "Future" column. Explore whether financial savings are expected to result from these actions. If so, ask how much the students' families considered that in the decision to conserve. Would they have done it anyway? Or were the prospect of financial savings a major motivation?

3. Calculate (you may have done this already) current class-wide CO_2 conservation. Congratulate them on a job well done. Calculate (you may have done this already) potential class-wide savings in CO_2 and in dollars.

5. Suggest that the class consider a year long (or school-year long) analysis to see if there is a limit to what they can save as individuals and as a group. If students express interest, divide up and coordinate assignments.

SUGGESTED MODIFICATIONS (OPTIONAL)

☼ For upper grades, encourage students to make predictions on CO_2 savings that may be achieved by their school, town or city, region, or the entire United States if conservation steps are undertaken. These measures could include, for example, increased use of mass transit, more efficient insulation and lighting of public buildings, developing High-Occupancy Vehicle (HOV) programs for local highways to encourage car pooling, and restricting traffic in specific areas of the city. Results could be presented to the local school board or the city (town) council to introduce students to the political aspects of conservation.

SUGGESTED READING

Baker, Susan. *First Look at Using Energy*. Milwaukee, WI: Gareth Stevens (1991).

Javna, John, et al. *50 Simple Things Kids Can Do To Save the Earth*. Andrews and McMeel (1990).

Klaber, K. A., K. N. Weiss, and J. W. Gallagher. "Charting a Course through the Clean Air Act Amendments." *National Environmental Journal*, (November 1993)

U.S. EPA. *Office of Radiation and Indoor Air: Program Description*. Washington, DC: U.S. EPA, Office of Air and Radiation EPA/402/K-93/002 (June 1993).

Yanda, Bill. *Rads, Ergs, and Cheeseburgers: The Kid's Guide to Energy and the Environment*. Norton (1991).

STUDENT WORKSHEET 1
ACTION = SAVINGS IN CO_2 + $
INVENTORY OF CURRENT USE

1) AUTOMOBILES

Rule of thumb: Every gallon of gasoline used by an automobile costs approximately $1.10 and releases about 20 lbs. of CO_2.

For each automobile in your household, calculate the daily and annual fuel cost and CO_2 emissions:

TABLE 1

	Auto 1	Auto 2	Auto 3
Miles per Gallon (MPG)			
Cost per Mile (CPM) = $1.10÷MPG			
CO_2 Emissions per Mile (EPM) = 20 lbs.÷MPG			
Daily Miles (DM)			
Daily Cost = CPM x DM			
Daily Emissions of CO_2 = EPM x DM			
Annual Miles (AM) = DM x 365 or actual mileage if known			
Annual Cost = CPM x AM			
Annual Emissions of CO_2 = EPM x AM			

Daily commuting: A bus gets about 8 miles per gallon of gasoline (CPM = $0.14) and releases about 22 lbs. of CO_2 per gallon (EPM = 2.75 lbs.). Using the above daily cost and emission figures for Auto 1, calculate the savings if 20 people rode the bus rather drove the same distance in the same type of car.

20 Cars

Daily Cost (from above) x 20 = _____
Daily Emissions (from above) x 20 = _____

1 Bus

Daily Cost = DM (from above) x $0.14 = _____
Daily Emissions = DM (from above) x 2.75 lbs. = _____

If you or anyone in your family uses an alternative to driving for daily commuting (for example, to work or school), calculate the total annual savings in money and CO_2:

_____

2) ELECTRIC LIGHTING

Rule of thumb: Every kilowatt-hour of electricity consumed costs $0.085 releases 0.5 lbs. of CO_2.

Calculate the CO_2 and money you save at home now.

For each 27-watt compact fluorescent light bulb:
160 lbs. of CO_2 and $58/year _____

For each 18-watt compact fluorescent light bulb:
120 lbs. of CO_2 and $43/year _____

3) HOME HEATING AND COOLING

Type of heating fuel (for example, electric, oil*, natural gas*):
* Dollar figures associated with oil and natural gas savings are not available.

If you turn the heat down in your home overnight or when no one is home:

By 10 degrees, save:	electric:	2,070 lbs. CO_2 and $745/year	_____
	oil:	1,260 lbs./year	_____
	gas:	900 lbs./year	_____
By 5 degrees, save:	electric:	1,000 lbs. CO_2 and $360/year	_____
	oil:	610 lbs./year	_____
	gas:	440 lbs./year	_____

If your furnace has received tune-up within last year:

electric:	1,030 lbs. CO_2 and $371/year	_____
oil:	640 lbs./year	_____
gas:	450 lbs./year	_____

If your air conditioner has received tune-up within last year:
220 lbs. CO_2 and $80/year _____

If doors and windows are insulated (weather-stripping):

electric:	1,600 lbs. CO_2 and $576/year	_____
oil:	1,000 lbs./year	_____
gas:	700 lbs./year	_____

If your home water heater has an insulation jacket:

electric:	600 lbs. CO_2 and $216/year	_____
oil:	360 lbs./year	_____
gas:	260 lbs./year	_____

4) RECYCLING

What products do you recycle in your home (aluminum cans, steel cans, plastic jars and bottles, newspaper)?

Estimate the number of aluminum and steel cans and the number of glass bottles that you recycle annually. If you are not sure, keep track of the number of items recycled in one week and multiply by 52.

Every 10 aluminum or steel cans recycled saves 4 lbs. of CO_2. Every 10 glass bottles recycled saves 3 lbs. of CO_2. Calculate the amount of CO_2 you currently save annually by recycling aluminum, steel, and glass: _____

If you recycle newspapers: 50 lbs./year _____

5) TOTAL

Add up the amount of CO_2 and the money you and your family save every year as a result of the steps listed above:

CO_2 = _____
$ = _____

STUDENT WORKSHEET 2

ACTION = SAVINGS IN CO_2 + $

CO_2 AND $ SAVINGS

1) AUTOMOBILES

CPM (from Table 1 of the Inventory of Current Use): _____

EPM (from Table 1 of the Inventory of Current Use): _____

Automobile miles and gasoline consumption may be reduced in a number of ways:

- a person walks, bikes, or takes public transportation instead of driving
- car errands are combined
- car pooling

In addition, if your family switches to a more fuel efficient car, it will save money and reduce CO_2 emissions. If your family' car(s) gets less than 30 miles per gallon (MPG), compare to a car that gets 30 MPG. Use the data from Table 1 of the Inventory of Current Use to complete Table 2 for up to two cars.

TABLE 2

	Auto 1	Auto 2	Compare
Miles per Gallon (MPG)			30
Cost per Mile (CPM) = $1.10÷MPG			$0.037
CO_2 Emissions per Mile (EPM) = 20 lbs.÷MPG			0.67
Daily Miles (DM)			
Daily Cost = CPM x DM			
Daily Emissions of CO_2 = EPM x DM			
Annual Miles (AM) = DM x 365 or actual mileage if known			
Annual Cost = CPM x AM			
Annual Emissions of CO_2 = EPM x AM			

How much would you and your family save if you switched to more fuel efficient cars?

$ = _____

CO_2 = _____

For every annual mile saved from current automobile usage, add one CPM and EPM unit. Total your savings in fuel costs and CO_2 if you reduce driving and switch to fuel efficient automobiles:

$ = _____

CO_2 = _____

2) ELECTRICITY

Rule of thumb: Every kilowatt-hour of electricity consumed costs $0.085 releases 0.5 lbs. of CO_2.

If you replace conventional incandescent light bulbs with compact fluorescent light bulbs, you will save money on electricity and reduce CO_2 emissions. (27-watt compact fluorescent bulbs replace 75-watt incandescent bulbs; 18-watt fluorescent bulbs replace 60-watt incandescent bulbs.)

For each 27-watt compact fluorescent light bulb:
160 lbs. of CO_2 and $58/year _____
For each 18-watt compact fluorescent light bulb:
120 lbs. of CO_2 and $43/year _____

3) HOME HEATING AND COOLING

Type of heating fuel (for example, electric, oil*, natural gas*): _____
* Dollar figures associated with oil and natural gas savings are not available.

If you begin to turn the heat down in your home overnight or when no one is home:
By 10 degrees, save:

electric:	2,070 lbs. CO_2 and $745/year	_____
oil:	1,260 lbs./year	_____
gas:	900 lbs./year	_____

By 5 degrees, save:

electric:	1,000 lbs. CO_2 and $360/year	_____
oil:	610 lbs./year	_____
gas:	440 lbs./year	_____

If your furnace receives a tune-up within the next year:

electric:	1,030 lbs. CO_2 and $371/year	_____
oil:	640 lbs./year	_____
gas:	450 lbs./year	_____

If your air conditioner receives a tune-up within the next year:
220 lbs. CO_2 and $80/year _____
If you insulate doors and windows with weather-stripping:

electric:	1,600 lbs. CO_2 and $576/year	_____
oil:	1,000 lbs./year	_____
gas:	700 lbs./year	_____

If you put an insulation jacket on your home water heater:

electric:	600 lbs. CO_2 and $216/year	_____
oil:	360 lbs./year	_____
gas:	260 lbs./year	_____

4) RECYCLING

Every 10 aluminum or steel cans recycled saves 4 lbs. of CO_2. Every 10 glass bottles recycled saves 3 lbs. of CO_2. What products can you begin to recycle in your home (aluminum cans, steel cans, plastic jars and bottles, newspaper)?

Estimate the number of aluminum and steel cans, and the number of glass bottles that you will recycle annually. If you are not sure, keep track of the number of items recycled in one week and multiply by 52.

Calculate the amount of CO_2 you can save annually by recycling aluminum, steel, and glass: _____

If you begin to recycle newspapers:
50 lbs./year _____

5) TOTAL

Add up the amount of CO_2 and the money you and your family could save every year as a result of the steps listed above:
CO_2 = _____
$ = _____